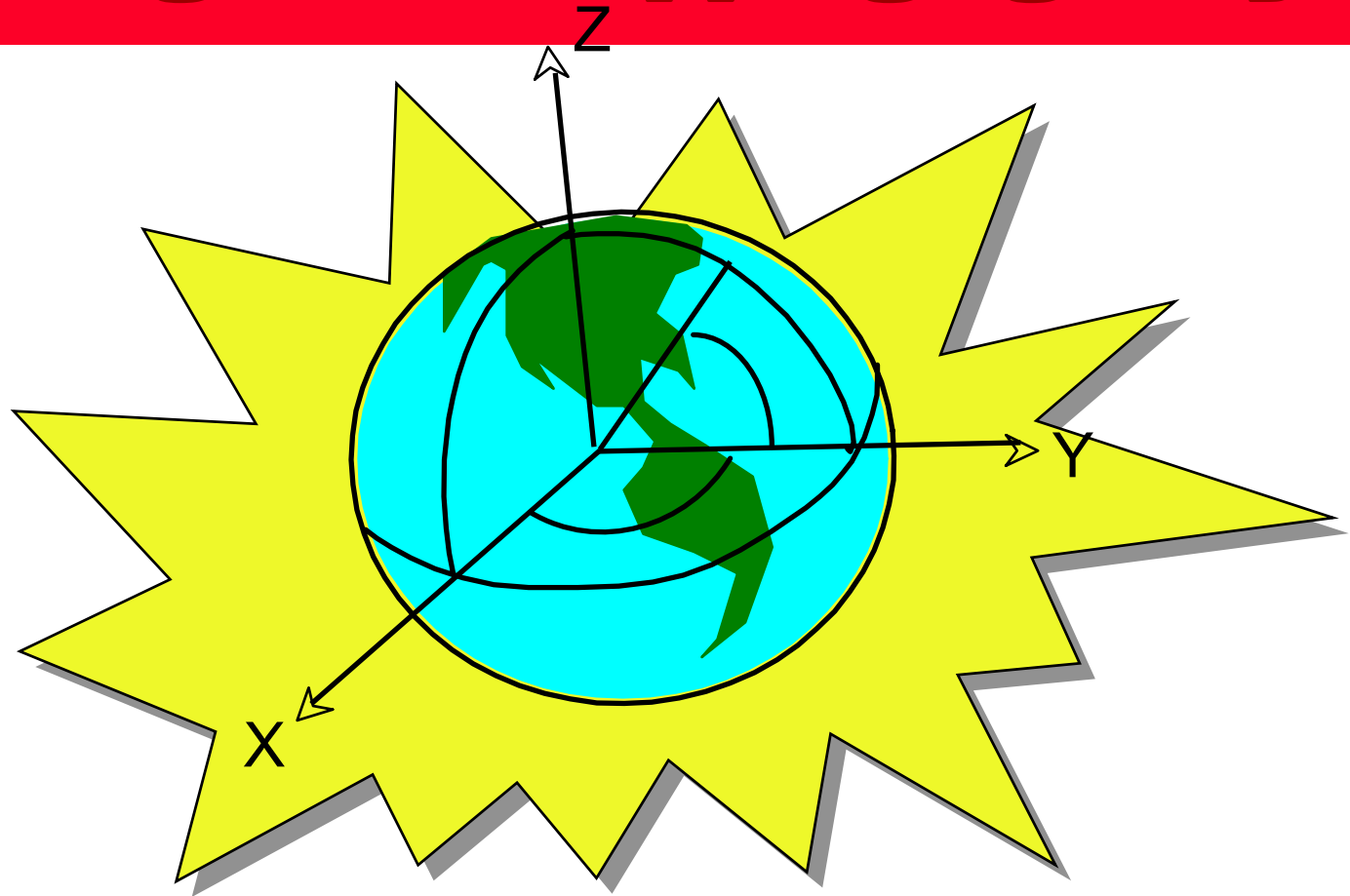# Geographic Datums

## Slides modified from National Image and Mapping Agency

ITEMS DEFINED

- ***Location*** the position of a point on the earth's surface
- ***Horizontal Datum*** specifies a mathematical approxima-tion of the earth's shape (ellipsoid)
- ***Ellipsoid*** simplified mathematical surface
- ***Vertical Datum*** provides a reference for the measure-ment of elevation (geoid)
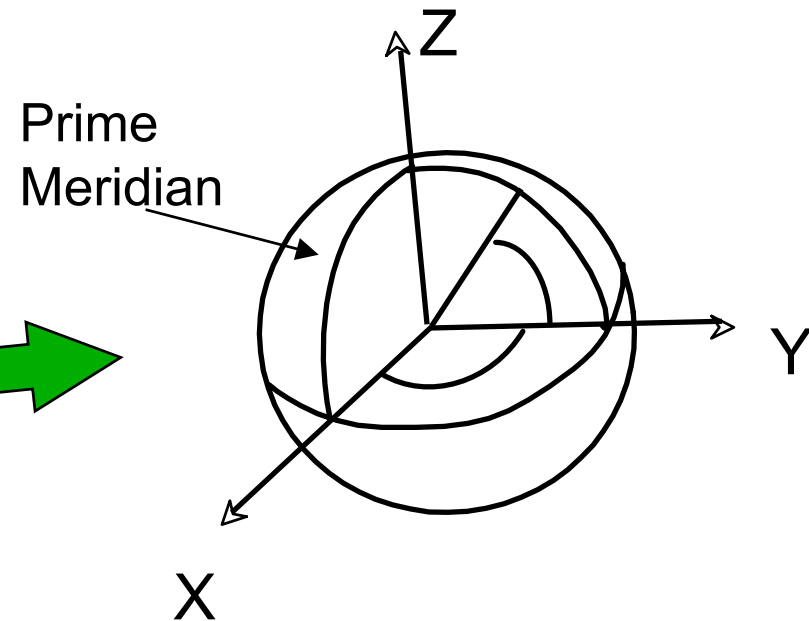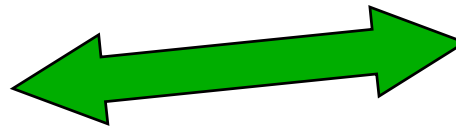- ***Geoid*** a surface of equal potential
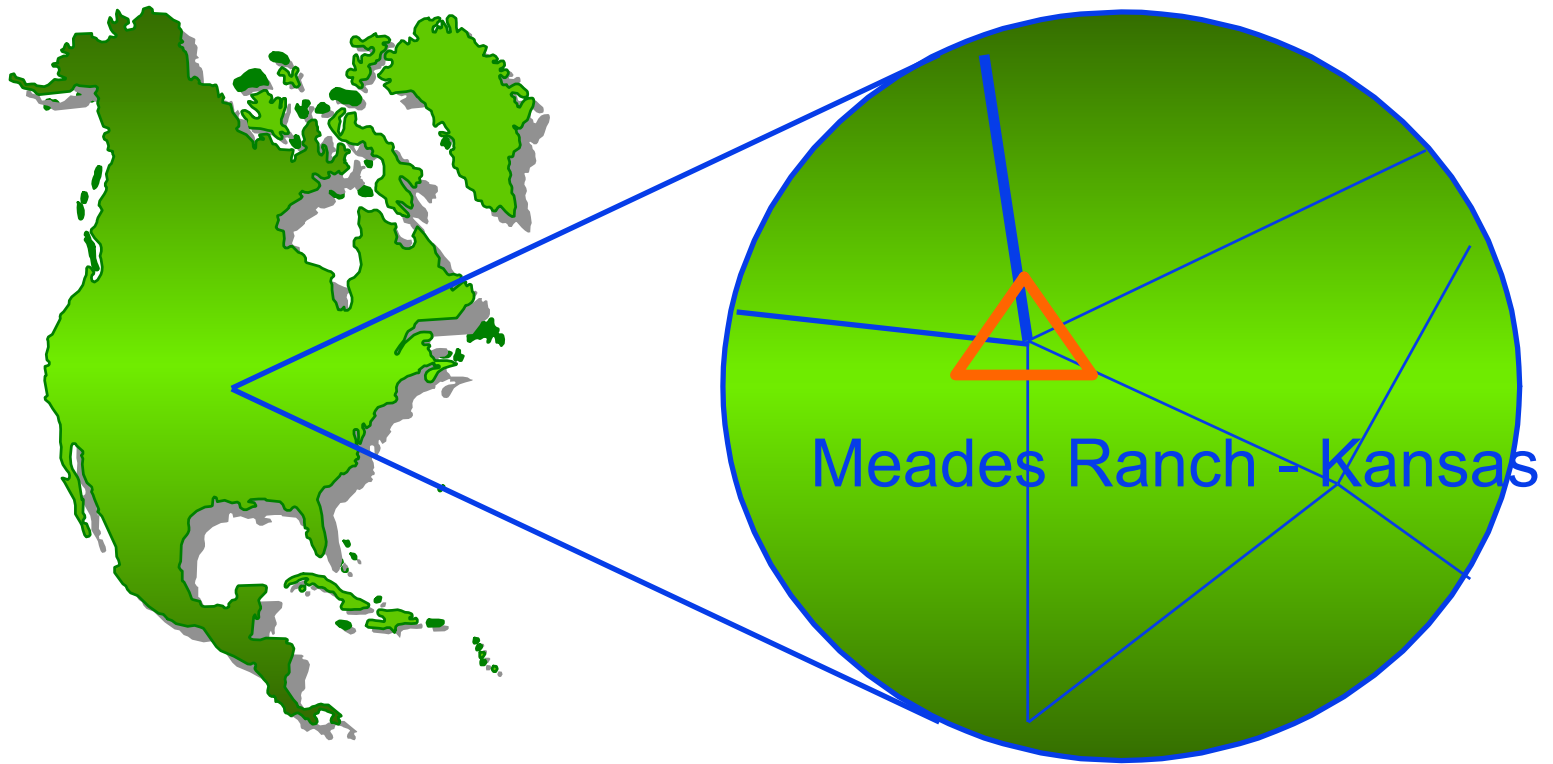
What is Location?

A Coordinate Approach
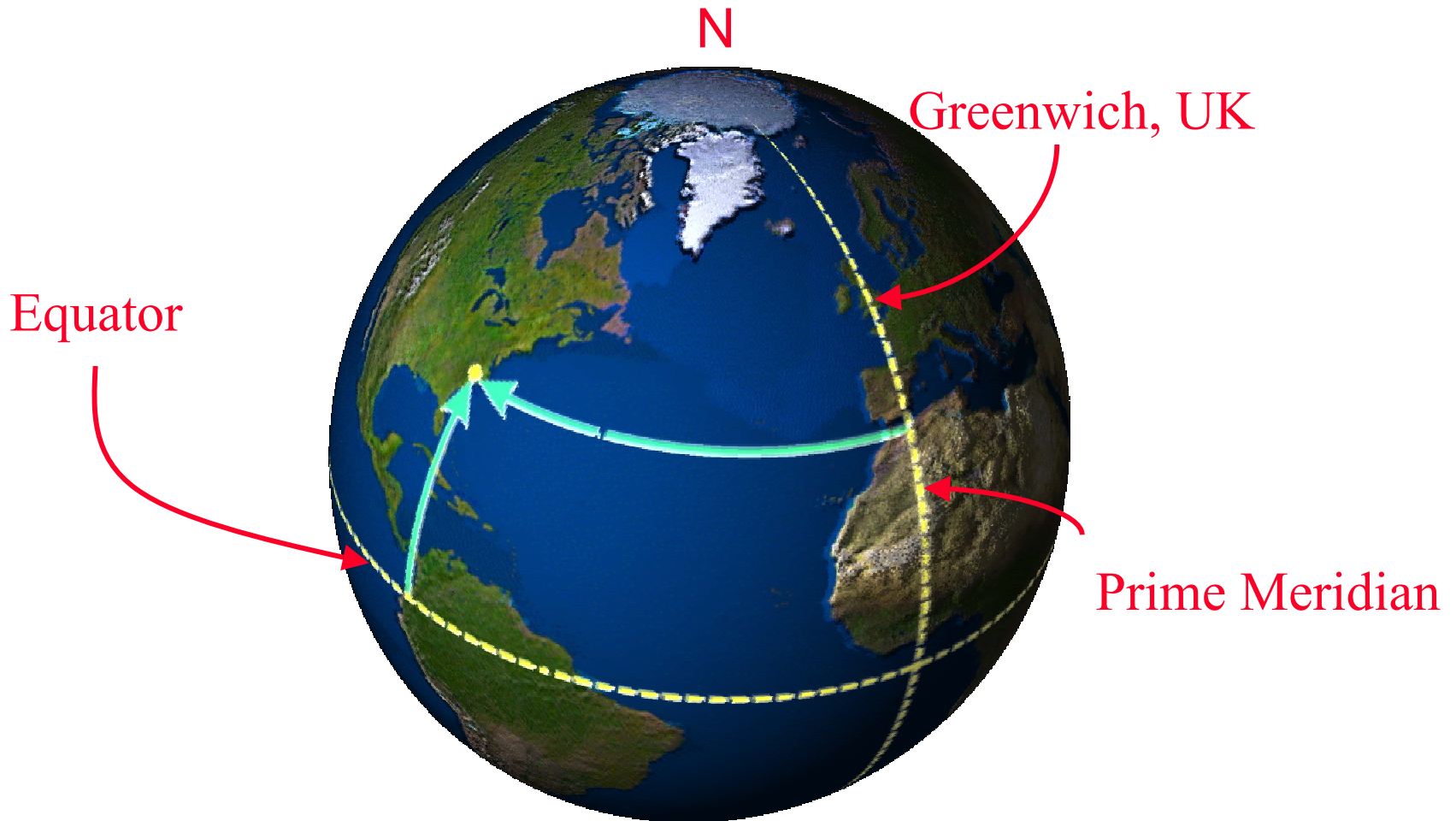
Horizontal Datum

Horizontal Datum - A base reference for a coordinate system. It includes the position of an initial point of origin and the orientation of an ellipsoid that models the surface of the earth in the region of interest.

Prime Meridian

Z

Y

X

NAD27 Example

North America circa 1927

Meades Ranch - Kansas

Clarke Ellipsoid (1866)

Datum/Ellipsoid pairs

European Datum International

North American Datum Clarke 1866

WGS72 Datum

Tokyo Datum Bessel

South American Datum International

Arc Datum Clarke 1880
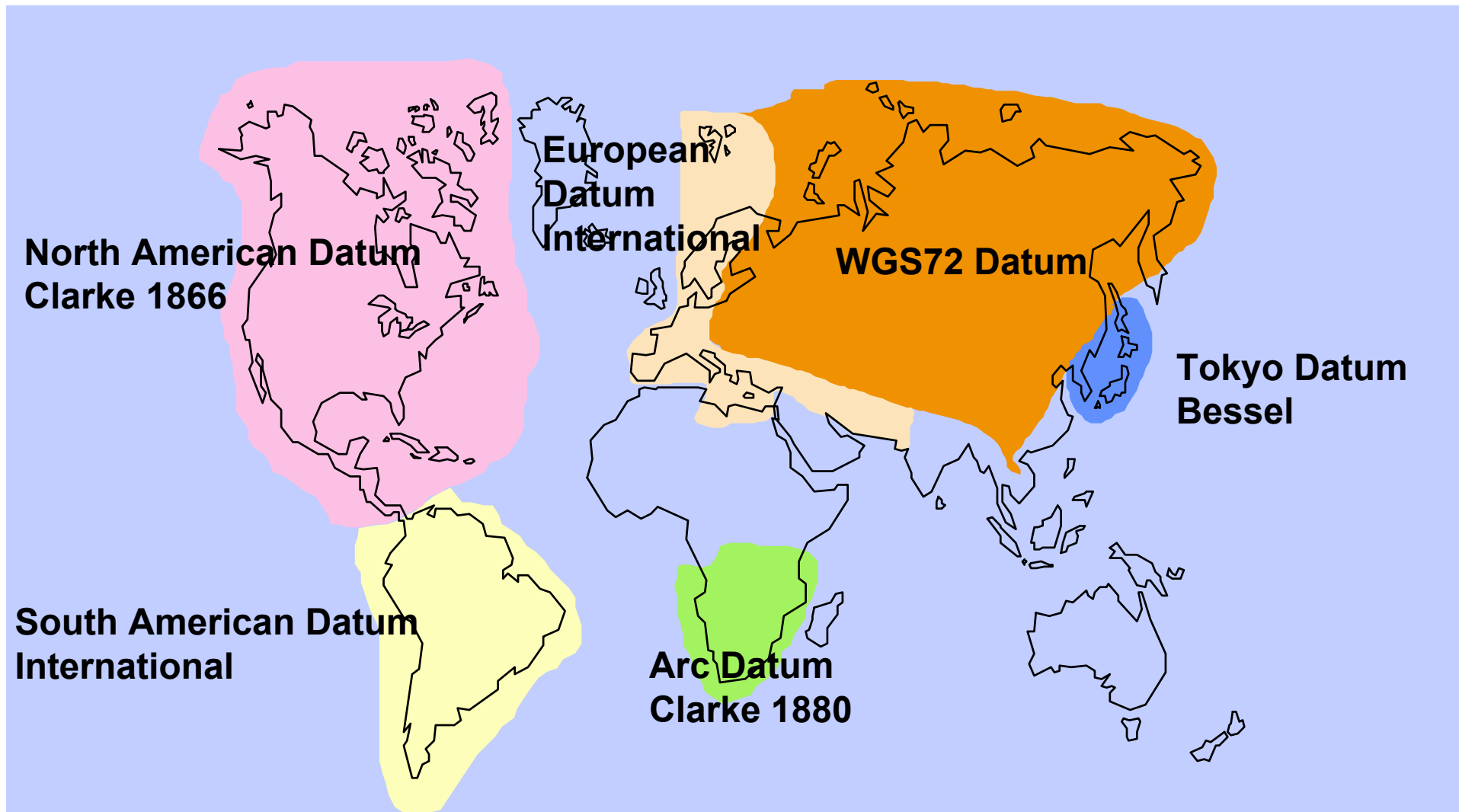
Why do we need an ellipsoid?
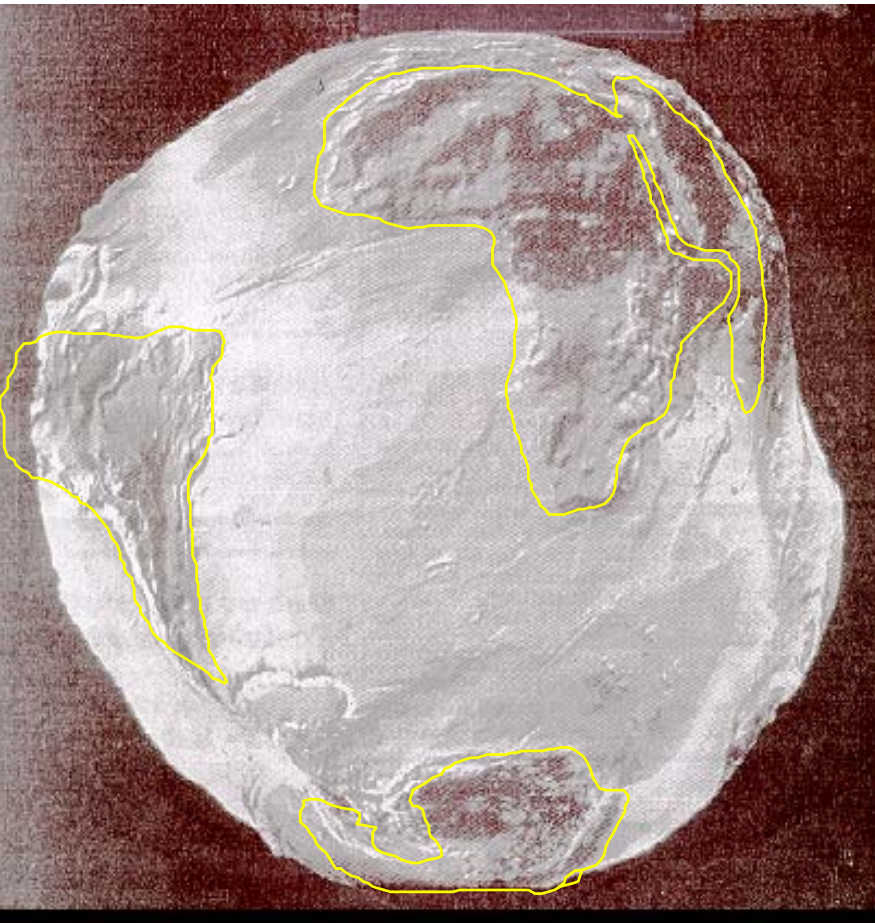
This image depicts the earth's shape without water and clouds. It looks like a sloppily peeled potato, not a smoothly shaped ellipsoid.

Calculation of geographic position on this irregular surface is very complex. A simpler model is needed.

This simplified mathematical surface is an ellipsoid.

Horizontal Datums

NAD 27
(Clarke Ellipsoid)

ED 50
(International Ellipsoid)
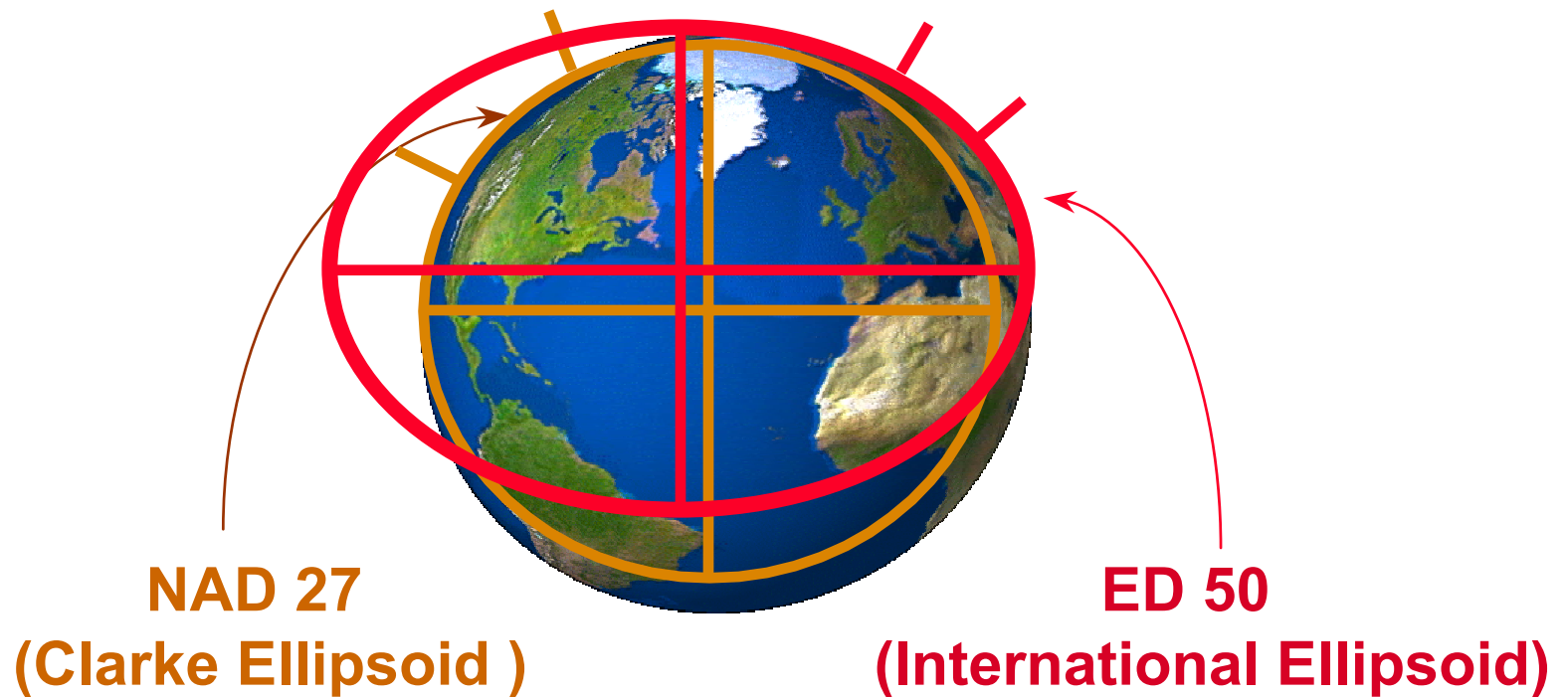
Vertical Datum

Like horizontal measurements, elevation only has meaning when referenced to some start point.

MSL Elevation

High Tide

Mean Sea Level

Low Tide

Mean sea level is the most common vertical datum.
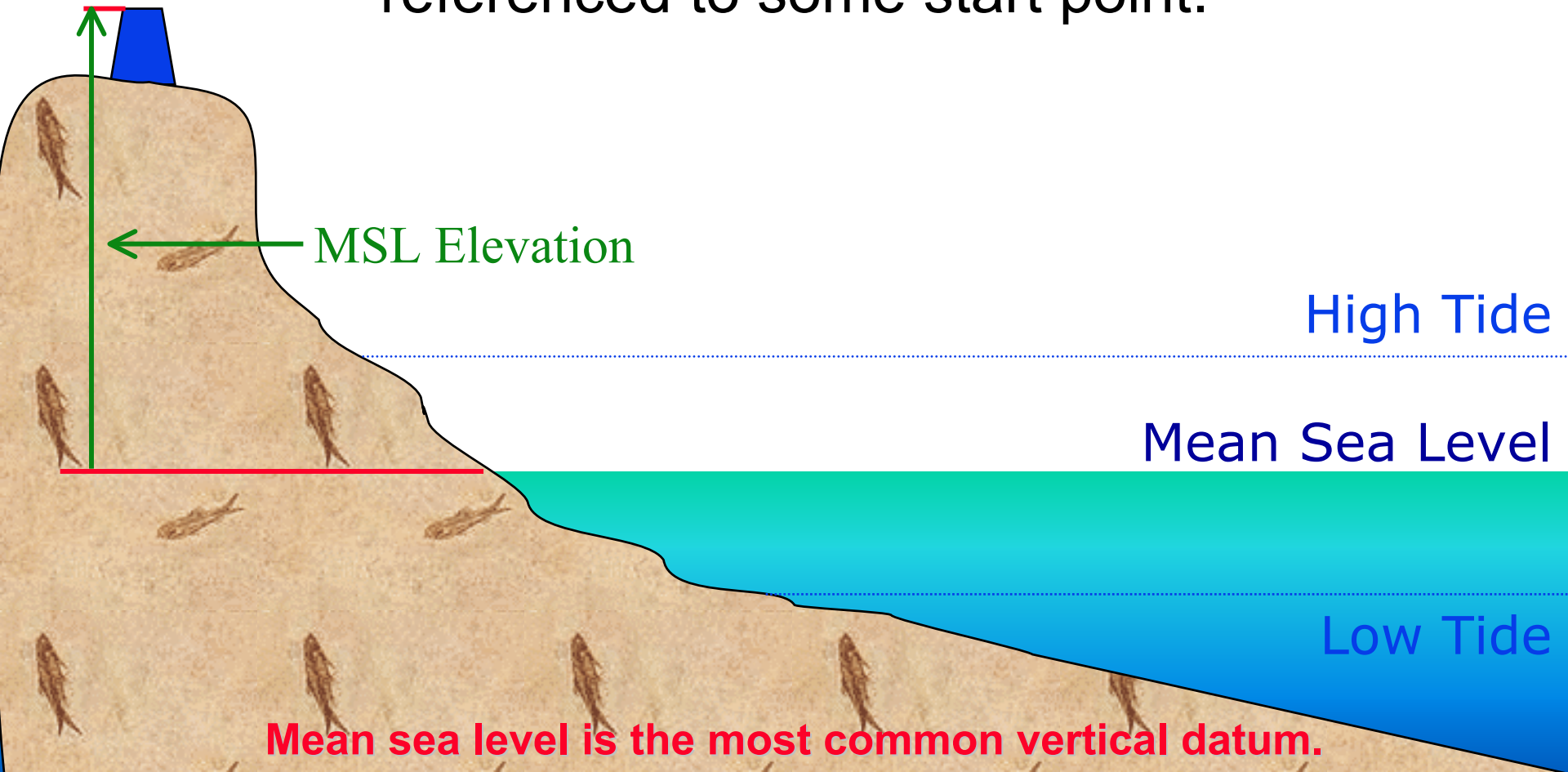
Geoid

A Gravitational Surface of Equal Potential, which Approximates Mean Sea Level.

Equipotential Surface
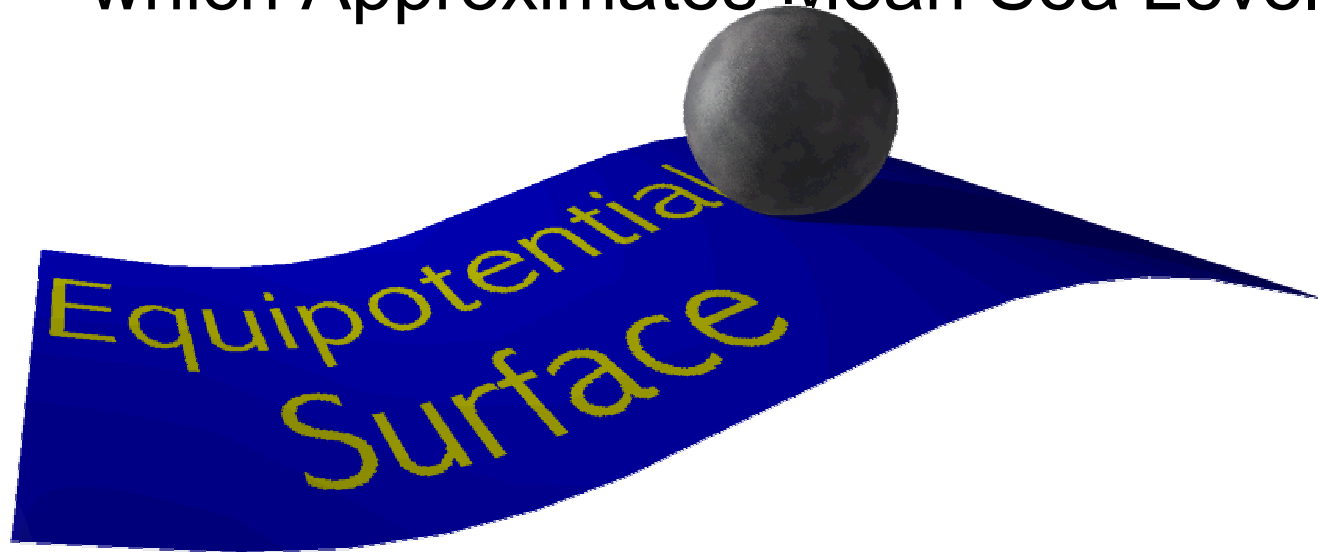
Shape of the Geoid

The Geoid is an undulating surface, not smooth and regular, due to density variations inside the earth.
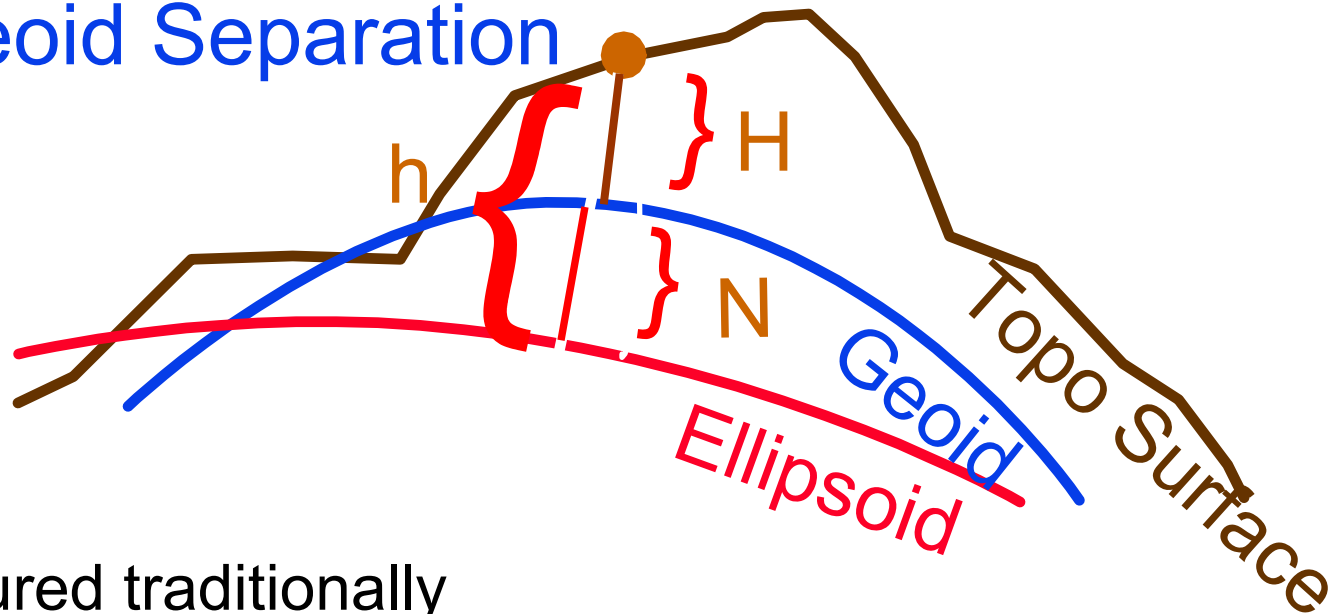

Density Variations
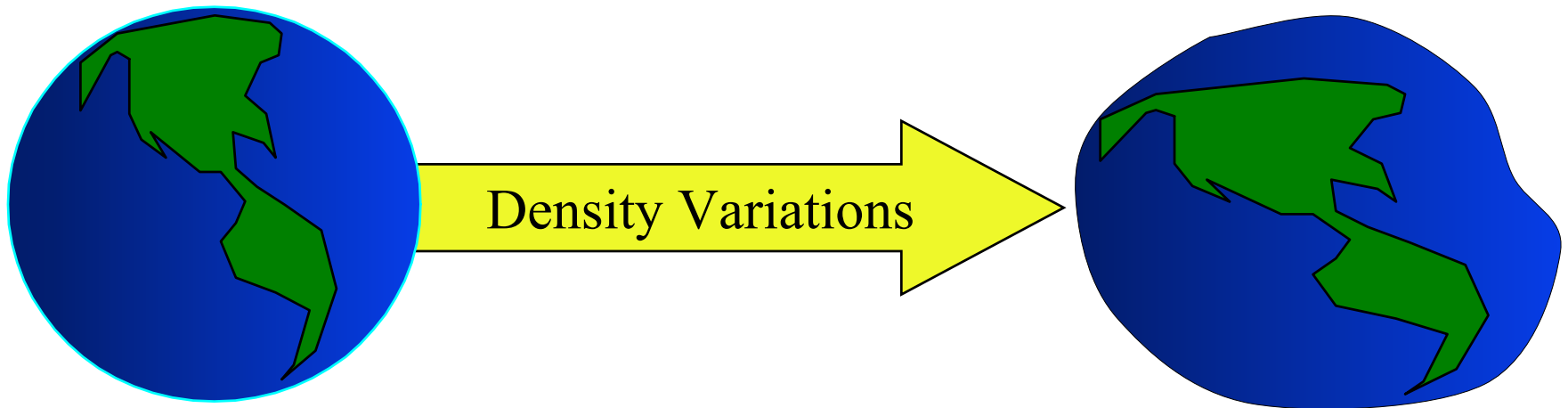
Geoid - Ellipsoid Separation

Defining the Vertical Position

H - Orthometric Height
(Height above <u>Mean Sea Level</u>)

h - Geodetic Height
(Height above Ellipsoid)

N - Geoid Separation

h

} H

} N

Topo Surface

Geoid

Ellipsoid

H is measured traditionally
h is approximately = N+H
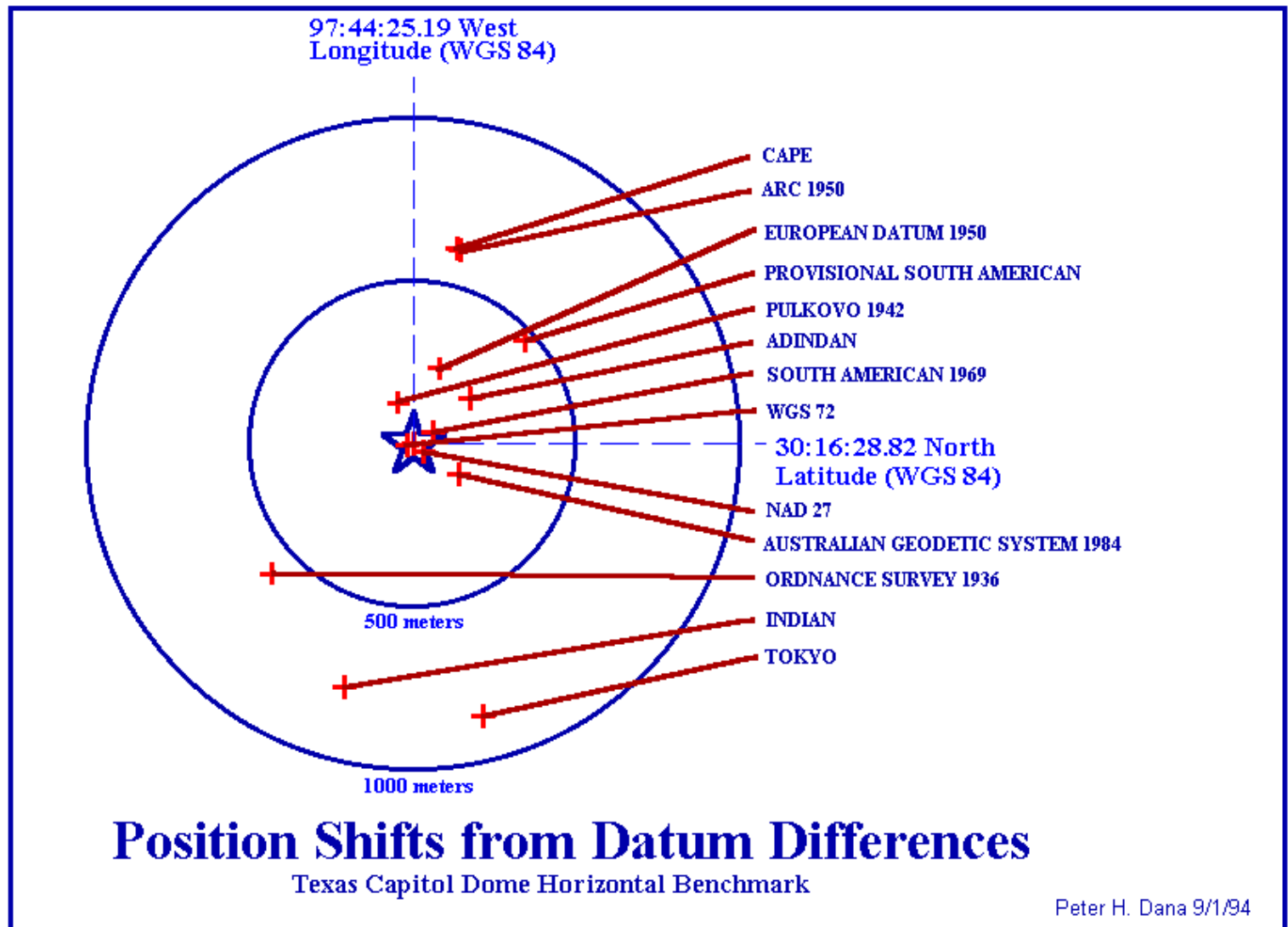N is modeled using Earth Geoid Model

Datums & Coordinates Items

- Know What Datums Are Needed for your applications

- Always Pass Datums w/Coordinates and Elevations

- Understand Coordinate System in Use

Review

• Horizontal and Vertical Datums provide a frame of reference in which to calculate locations and elevations

• A horizontal datum definition requires an initial point location, orientation, and an ellipsoid

• NAD 27 is the datum used on USGS 7 1/2 and 15 minute quads

• NAD 83 is the datum used on the newer USGS metric series maps

• Gravity affects horizontal and vertical instrument measurements

• Datum mismatches can cause serious map placement errors

Horizontal Datum Shifts

Position Shifts from Datum Differences

Texas Capitol Dome Horizontal Benchmark

Peter H. Dana 9/1/94

Environmental Information Management (EIM)

EIM Query System

Location Map: PALOUSE RIVER AT HOOPER

Click or drag on the map to:

- ● Zoom In
- ○ Zoom Out
- ○ Pan

Set background image to:

- ● USGS Topo Map
- ○ Aerial Imagery

Legend:

★ Selected EIM Location
◆ Other EIM Locations